Section 7

Chemical Emergencies

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Introduction

Release of chemical agents can occur via unintended or deliberate means, such as through a spill from a damaged railroad tank car or explosion at an industrial facility with resultant contamination of air, food, water, or consumer products. Since September 11, 2001, concern has increased about potential terrorist attacks involving the use of toxic chemical agents to cause widespread panic and harm. Toxic chemical agents are poisonous vapors, aerosols, gases, liquids, or solids that have adverse effects on people, animals, or plants. Most are liquid at room temperature and are disseminated as vapors and aerosols. Chemicals may be released as bombs, sprayed from aircraft and boats, or disseminated by other means to intentionally create a hazard to people and the environment. Some of these agents are highly toxic and persistent, features that can render a site uninhabitable and require costly and potentially hazardous decontamination and remediation.

Health effects of toxic chemical agents range from irritation and burning of eyes, skin, and mucous membranes to rapid cardiopulmonary collapse and death. Such effects may be immediate (a few seconds) or delayed (several hours to days). Immediate symptoms of exposure to chemical agents may include blurred vision, eye irritation, difficulty breathing, and nausea. Affected persons may require urgent medical attention.

Several patients presenting with the same symptoms should alert physicians and hospital staff to the possibility of a chemical attack. If an attack occurs, most victims will likely arrive at the hospital within a short time period. This situation differentiates a chemical attack from a biological attack involving infectious microorganisms.

Toxic chemical agents have a high potential for secondary contamination from victims to responders. This requires that medical treatment facilities have clearly defined procedures for handling contaminated casualties, many of whom will transport themselves to the facility. Precautions must be used until thorough decontamination has been performed or the specific chemical agent is identified. Health care professionals must first protect themselves (eg, by using protective suits, respiratory protection, and chemical-resistant gloves) because secondary contamination with even small amounts of these substances (particularly nerve agents such as VX) can be lethal.

Efficient deployment of hazardous materials (hazmat) teams is critical to control a chemical agent attack. Although all major cities and emergency medical systems have plans and equipment in place to address this situation, physicians and other health professionals must be aware of principles involved in managing a patient or multiple patients exposed to these agents.

This section provides quick access to current information on preparing for a chemical emergency, handling contaminated persons, hazard assessment, health effects, and accessing emergency assistance. It is intended to help physicians and other health care professionals recognize chemical-related illnesses and the need to notify appropriate authorities. With adequate resources and planning, health care professionals and the public can better prepare themselves to recognize an emergency situation and react effectively to protect themselves and others from harm. Some of the links also provide helpful information for medical responses to other public health emergencies.

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AMA Quick Reference Guide: Chemical Weapons

Crude Identification of Chemical Agent Class Based on the Time Lag Between Exposure and Onset of Symptoms and Signs

Precipitous Onset	Rapid Onset	Delayed Onset
Choking agent (chlorine)	Nerve agent (inhaled)	Nerve agent (absorbed)
Blister agent (Lewisite)	Cyanide agent	Blister agent
Incapacitating agent	Vomiting (arsine-based) agents	Choking agent (phosgene)
Riot control agents	Liquid in eye (mustard gas)	

Initial Identification of Chemical Agent Class Based on Early Signs and Symptoms of Exposure

Organ/System Affected	Signs/Symptoms	Chemical Agent(s) to Consider
Central Nervous System	Convulsions	Nerve; cyanide
	Confusion, odd behavior	Incapacitating
	Stupor	Any agent
Respiratory	Copious oro-nasal secretions	Nerve
	Chest pain, wheezing	Nerve; choking; blister
	Frothy sputum	Blister; choking
	Hyperpnea, dyspnea	Choking; blister; cyanide
	Apnea	Nerve; cyanide
	Cyanosis	Cyanide; nerve; choking
Circulatory	Bradycardia	Nerve; blood
	Tachycardia	Cyanide; nerve; incapacitating
	Shock	Any agent
Skin	Hot, dry, flushed	Incapacitating
	Vesication	Blister
	Pain on contact	Blister (ie, Lewisite)
	Muscle tremors	Nerve
	Erythema	Unknown liquid
Gastrointestinal	Involuntary evacuation	Nerve
	Vomiting	Any agent

Exposure to Toxic Chemical Agents: Clinical Considerations

Chemical Agent[1]	Diagnostic Considerations	Clinical Effects	Treatment Considerations[2]
CYANIDES			
Cyanogen chloride (CK) Hydrogen cyanide (AC)	Symptom onset: rapid, seconds to minutes Odor: smell of "bitter almonds" but also described as musty or chlorine-like Nonspecific hypoxic and hypoxemic symptoms; no well-defined toxidrome Binds cellular cytochrome oxidase causing chemical asphyxia CNS effects may be confused with carbon monoxide and hydrogen sulfide poisoning Laboratory testing: cyanide, thiocyanate, serum lactate levels; venous and arterial partial oxygen pressure	Respiratory: shortness of breath, chest tightness, hyperventilation, respiratory arrest GI: nausea, vomiting Cardiovascular: ventricular arrhythmias, hypotension, cardiac arrest, shock CNS: anxiety, headache, drowsiness, weakness, apnea, convulsions, seizure, coma Metabolic acidosis and increased concentration of venous oxygen (patient also may present with cyanosis) ***Moderate exposure:*** nonspecific findings, gasping, flushing, (typically not cyanosis) ***High exposure:*** convulsions, cessation of respiration	Immediate treatment of symptomatic patients is critical Antidote: sodium nitrite and sodium thiosulfate; repeat one-half of initial doses of both agents in 30 minutes if there is inadequate clinical response Amyl nitrate capsules are commercially available for first aid until intravenous access is achieved "Cyanide Antidote Kits" are commercially available Investigational in United States (available in Europe): hydroxycobalamin (vitamin B12a) administered with thiosulfate Activated charcoal for oral exposure Mechanical ventilation as needed Circulatory support with crystalloids and vasopressors Correct metabolic acidosis with IV sodium bicarbonate Seizures controlled with benzodiazepines

Exposure to Toxic Chemical Agents: Clinical Considerations continues

Chemical Agent[1]	Diagnostic Considerations	Clinical Effects	Treatment Considerations[2]
INCAPACITATING AGENTS			
Agent 15 3-quinuclidinyl benzilate (BZ)	Symptom onset: hours Odorless Competitive inhibitor of acetylcholine muscarinic receptor	0-4 h: parasympathetic blockade and mild CNS effects (eg, decreased level of consciousness, confusion, disorientation) 4-20 h: stupor with ataxia and hyperthermia 20-96 h: full-blown delirium Resolution phase: paranoia, deep sleep, reawakening, crawling, climbing automatisms, eventual reorientation "Anticholinergic toxidrome": mydriasis, blurred vision, dry mouth, dry skin, possible atropine-like flush, initial rise in heart rate	Antidote: physostigmine salicylate Support: intravenous fluids
NERVE AGENTS			
Cyclohexyl sarin (GF) Sarin (GB) Soman (GD) Tabun (GA) VX	Symptom onset: vapor (seconds), liquid (minutes to hours); symptom onset may be delayed up to 18 hours, particularly for localized exposures Odor: none (GB, VX), fruity (GA), camphor-like (GD) Most toxic of known chemical agents Irreversible acetylcholinesterase inhibitors May be confused with organophosphate and carbamate pesticide poisoning Laboratory testing: erythrocyte or serum cholinesterase activity to confirm exposure	Eyes: excessive lacrimation, miosis may be present Respiratory: rhinorrhea, bronchospasm, respiratory failure GI: hypersalivation, nausea, vomiting, diarrhea Skin: localized sweating Cardiac: sinus bradycardia may be present Skeletal muscles: fasiculations followed by weakness, flaccid paralysis CNS: loss of consciousness, convulsions, apnea, seizures	Rapid establishment of patent airway Antidote: Atropine and pralidoxime chloride (2-PAM); additional doses until bronchial secretions are cleared and ventilation improved Early administration of pralidoxime is critical to minimize permanent agent inactivation of acetylcholinesterase (ie, "aging") Benzodiazepines to control nerve agent-induced seizures Airway and ventilatory support as needed Atropine, pralidoxime, and diazepam are available in autoinjector kits through the US military

Exposure to Toxic Chemical Agents: Clinical Considerations continues

Chemical Agent[1]	Diagnostic Considerations	Clinical Effects	Treatment Considerations[2]
PULMONARY OR CHOKING AGENTS			
Acrolein Ammonia (NH_3) Chlorine (CL) Choloropicrin (PS) Diphosgene (DP) Nitrogen oxides (NO_x) Perflouroisobutylene (PFIB) Phosgene (CG) Sulfur dioxide (SO_2)	Symptom onset: rapid or delayed; 1-24 h (rarely ≤ 72 h) Odor (CG): freshly mown hay or grass Easily absorbed by mucous membranes of eyes, nose, oropharynx; degree of water solubility of the agent influences onset and severity of respiratory injury. Lung tissue damage may be confused with inhalation exposure to industrial chemicals (eg, HCl, Cl_2, NH_3) Chest radiograph: hyperinflation, noncardiogenic pulmonary edema	Eye and airway irritation, dyspnea, chest tightness, rhinorrhea, hypersalivation, cough, wheezing High-dose inhalation may produce laryngospasm, pneumonitis, and acute lung injury with delayed onset (≤ 48 h) of acute respiratory distress syndrome	No specific antidotes Supportive measures: specific treatment depends on the agent IV fluids for hypotension; no diuretics Ventilation with or without positive airway pressure Bronchodilators for bronchospasm Methylprednisolone may be effective in preventing noncardiogenic pulmonary edema
RIOT CONTROL AGENTS			
Mace (CN) Tear gas (CS)	Symptom onset: immediate Odor: apple blossom (CN); pepper (CS) Metallic taste Burning and pain on mucosal membranes and skin SN2 alkylating agents No specific laboratory tests	Eyes: irritation, pain, tearing, blepharospasm Airways: burning in nose and mouth, respiratory discomfort, bronchospasm (may be delayed 36 h) Skin: tingling, erythema Nausea and vomiting common CN can cause corneal opacification	Supportive Irrigation as necessary Persons with asthma, emphysema may need oxygen, inhaled bronchodilators, steroids, assisted ventilation Lotions such as calamine for persistent erythema

Exposure to Toxic Chemical Agents: Clinical Considerations continues

Chemical Agent[1]	Diagnostic Considerations	Clinical Effects	Treatment Considerations[2]
VESICANT OR BLISTER AGENTS			
	Symptom onset: immediate (L, CX); delayed 2-48 h (H, HD) Vapor and liquid threat to all exposed skin and mucous membranes May be confused with skin exposure to caustic irritants (eg, sodium hydroxide, ammonia) Intracellular enzyme, RNA, and DNA alkylating agents No specific laboratory tests; detection based on clinical signs and symptoms	Clinical effects dependant on extent and route of exposure; effects may be delayed, appearing hours after exposure	Immediate decontamination Supportive care Thermal burn-type treatment Symptomatic management of lesions
Sulfur mustard (H) Distilled mustard (HD)	Symptom onset: delayed, 2-48 h Odor: garlic, horseradish, or mustard	Skin: erythema and blisters (may be delayed ≤ 8 h), pruritus Eye: irritation, conjunctivitis, corneal damage, lacrimation, pain, blepharospasm Respiratory: mild to marked acute airway damage, pneumonitis within 1-3 d, respiratory failure GI: nausea, vomiting, diarrhea may be present Bone marrow stem cell suppression leading to pancytopenia and increased susceptibility to infection Fever, sputum production Combination with Lewisite (called mustard-Lewisite or HL) results in rapid effects of Lewisite and delayed effects of mustard agents	No antidote Skin: silver sulfadiazine Eye: homatropine ophthalmic ointment Pulmonary: antibiotics, bronchodilators, steroids Colony-stimulating factor may be helpful for leukopenia Systemic analgesic and antipruritics Early use of positive end-expiratory pressure or continuous positive airway pressure Maintain fluid and electrolyte balance (do not excessively fluid resuscitate as in thermal burns)

Exposure to Toxic Chemical Agents: Clinical Considerations continues

Chemical Agent[1]	Diagnostic Considerations	Clinical Effects	Treatment Considerations[2]
Lewisite (L)	Symptom onset: immediate Odor: fruity or geranium More volatile than mustard Damages eyes, skin, and airways by direct contact	Skin: gray area of dead skin within 5 min, erythema within 30 min, blistering 2-3 h, immediate irritation or burning pain on contact, severe tissue necrosis Eyes: pain, blepharospasm, lacrimation, conjunctival and lid edema Airway: pseudomembrane formation, nasal irritation Intravascular fluid loss, hypovolemia, shock, organ congestion, leukocytosis	Antidote: British Anti-Lewisite (BAL or dimercaprol)
Phosgene oxime (CX)	Symptom onset: immediate Odor: freshly mown hay Urticant, non-vesicant agent Vapor extremely irritating, vapor and liquid cause tissue damage on contact No distinctive laboratory findings	Immediate pain and irritation to all exposed skin and mucous membranes followed by wheal-like skin lesions Eyes: extremely painful Airway: upper airway irritant, pulmonary edema	No antidote Parenteral methylprednisolone may prevent noncardiogenic pulmonary edema Experimental: aerosolized dexamethasone and theophylline for pulmonary involvement
VOMITING (ARSINE-BASED) AGENTS			
Adamsite (DM) Diphenylchlorarsine (DA) Diphenylcyanoarsine (DC)	Symptom onset: all rapidly acting within minutes Odor: none (DA), garlic (DC), burning fireworks (DM) Primary route of absorption is through respiratory system Arsine gas depletes erythrocyte glutathione resulting in hemolysis Chest radiograph to rule out chemical pneumonitis	Eye: conjunctival irritation, tearing, and blepharospasm, Airways: sneezing, mucosal lung irritation, edema, progressive cough, wheezing Cardiac: tachypnea, tachycardia GI: intestinal cramps, emesis, diarrhea Skin: erythema, edema at the site of dermal contact CNS: depression, syncope	Supportive care Monitor for hemolysis Wheezing or dyspnea may require albuterol inhalation Eye irrigation (water, normal saline, lactated Ringer's solution) in patients sustaining ocular exposure Treat repetitive emesis with IV hydration and antiemetics Blood transfusion may be required Exchange transfusion may be required Hemodialysis may be useful in decreasing arsenic level and treating renal failure

[1] Information on certain extremely potent chemicals called biotoxins (eg, ricin, mycotoxin, botulinum toxin) can be found in the AMA Quick Reference Guide in Section 6, Biological Emergencies.

[2] Different scenarios may require different treatment and dosage regimens. Consult other references as well as a regional poison control center, medical toxicologist, clinical pharmacologist, or other drug information specialist for definitive dosage information, especially dosages for pregnant women and children.

CNS: central nervous system

GI: gastrointestinal tract

IV: intravenous

Physicians should report noticeable increases in unusual illnesses, symptom complexes, or disease patterns (even without definitive diagnosis) to public health authorities. Prompt reporting of unusual patterns of illness can allow public health officials to initiate an epidemiologic investigation earlier than would be possible if the report awaited definitive etiologic diagnosis. Any suspicious or confirmed exposure to a toxic chemical agent should be reported immediately to the local health department and the **Centers for Disease Control and Prevention at 770-488-7100**. Any incident related to terrorism or possible terrorist activity also requires telephonic notification to the **National Response Center at 800-424-8802** and local Federal Bureau of Investigations office. This includes bombings, bomb threats, suspicious letters or packages, and incidents related to the intentional release of chemical, radiological, and biological agents.

If an unusual disease or possible outbreak is suspected, contact the state or local health department at:

http://www.statepublichealth.org

http://www.naccho.org/general8.cfm

Information contained in this table was current as of November 2004, and is intended for educational purposes only. Medication information should be researched and verified before initiation of patient treatment.

These tables were compiled from the following references:

Roy MJ, ed. Part III. Chemical Agents. In: *Physician's Guide to Terrorist Attack.* Totowa, New Jersey: Humana Press; 2004.

US Army Medical Research Institute of Chemical Defense (USAMRICD) Medical Management of Chemical Casualties Handbook (July 2000)

World Health Organization. Public Health Response to Biological and Chemical Weapons. Geneva: WHO; 2004

Other Quick Reference Guides

Biological and Chemical Agent Quick Reference Tables
U.S. Army Soldier and Biological Chemical Command, Edgewood Chemical Biological Center

Biological, Chemical, and Radiological Terrorism: An Overview of Indicators and Response
Medical Society of the State of New York

Chemical Agents Reference Chart
Medical Society of the State of New York

Chemical Agents: Emergency Response Cards
National Institute for Occupational Safety and Health (NIOSH)

Chemical Terrorism Pocket Guide
Department of Veterans Affairs (VA)

Chemical Terrorism Preparedness and Response Card
NY State Department of Health

Emergency Protocols for Management of Chemical Emergencies
Centers for Disease Control and Prevention (CDC)

Guide for Chemical Terrorism Identification
American College of Physicians (ACP)

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Key Points About Chemical Emergencies

Primary detection of exposure to chemical agents is based on the signs and symptoms of the potential victim.

Confirmation of a chemical agent, using detection equipment or laboratory analyses, will take considerable time and will not likely contribute to the early management of mass casualty victims.

A covert release of a chemical agent may be difficult to identify easily:

- Symptoms of exposure to some chemical agents can be similar to those of common diseases (eg, gastroenteritis)
- Immediate symptoms of certain chemical exposures might be nonexistent or mild despite the risk for long-term effects
- Exposure to contaminated food, water, or consumer products can result in reports of illness to health care professionals over an extended period of time and in various geographic locations
- Persons exposed to two or more agents might have symptoms not suggestive of any one chemical agent (ie, a mixed clinical presentation)
- Health care professionals might be less familiar with clinical presentations suggesting exposure to chemical agents than with illnesses they treat more frequently

Clinical effects from exposure to chemical agents will vary depending on the:

- Type of agent
- Route of exposure (eg, dermal, inhaled, ingested)
- Amount and concentration of agent
- Duration of exposure
- Pre-existing medical conditions (cardiac, pulmonary, neuromuscular)

Treating exposed persons by clinical syndrome rather than by specific agent probably is the most pragmatic approach to the treatment of illness caused by chemical exposures.

It is likely that many victims will arrive at hospitals by private vehicle without proper decontamination.

Precautions (eg, use of personal protective gear and decontamination) must be utilized by first responders to avoid contaminating themselves and other emergency personnel, as well as transport vehicles and treatment facilities.

Removal of clothing and washing with soap and copius amounts of water should be used to remove external chemical contamination.

Stress on patients and providers will cause further confusion; the potential for mass hysteria is high.

Epidemiologic Clues Suggesting a Covert Chemical Release

- An unusual increase in the number of patients seeking care for a rapid onset of symptoms after exposure to a potentially contaminated medium (eg, paresthesias and vomiting within minutes of eating a meal)
- Rapid onset of illness with little or no warning
- Unexplained illness or death among young or previously healthy persons
- Presence of an unexplained odor, low level clouds, or vapors at the scene
- Emission of unexplained odors by patients
- Clusters of illness in persons who have common characteristics, such as drinking water from the same source
- Unexplained death of plants, fish, or animals (domestic or wild)
- A syndrome (ie, a constellation of clinical signs and symptoms in patients) suggesting a disease associated commonly with a known chemical exposure
  - Sudden unexplained weakness, collapse, apnea, or convulsions in previously healthy persons
  - Dimmed or blurred vision
  - Hypersecretion syndromes (eg, tearing, drooling, diarrhea)
  - Inhalation syndromes (eye, nose, throat, chest irritation; shortness of breath)
  - Burn-like syndromes (redness, blistering, itching, sloughing)

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Key Medical Resources

Various chemical agents could be used as covert weapons, and the actual clinical syndrome will vary depending on the type of agent, the amount and concentration of the chemical, and the route of the exposure. The following resources provide comprehensive clinical information to help physicians and other health care professionals prepare for this possibility.

For immediate help in assessing clinical effects from chemical exposures, contact:

- Medical toxicologist, clinical pharmacologist, or other drug information specialist
- Regional Poison Control Center at 800-222-1222
- National Response Center Hotline at 800-424-8802
- CDC Emergency Hotline at 770-488-7100
- Chemical Transportation Emergency Center (CHEMTREC) 24-hour Emergency Response Hotline at 800-424-9300

American Academy of Pediatrics (AAP)

Chemical-Biological Terrorism and Its Impact on Children: A Subject Review

Reviews key aspects of chemical and biological agents, the consequences of their use, the potential impact of a terrorist attack on children, and issues to consider in disaster planning and management for pediatric patients

Army Medical Research Institute of Chemical Defense (USAMRICD)

Medical Management of Chemical Casualties Handbook

Provides medical personnel with a concise yet detailed reference source for the medical management of chemical casualties to include history, triage, diagnosis, and treatment

Field Management of Chemical Casualties Handbook

Provides military and civilian emergency response personnel with a concise reference source for the medical management of chemical casualties in a field environment. In addition to providing information on the various chemical agents and their emergency treatment, it also covers the set up of a medical decontamination line and detection/decontamination equipment and supplies used by the military for field medical decontamination.

Centers for Disease Control and Prevention (CDC)

Case Definitions for Chemical Poisoning
Case definitions to facilitate uniform reporting among health agencies of illness resulting from a chemical release.

Chemical Agents – Listed by Chemical

Chemical Agents – Listed by Category

Chemical Emergencies
Entry portal to comprehensive CDC Web site containing resources for the public and emergency responders to help them prepare for and cope with a chemical emergency

Emergency Procedures and Treatment Protocols for Chemical Emergencies
Preparations, victim arrival, initial treatment, identification of chemical agents, and protocols.

Laboratory Testing, Shipping, and Reporting: Information and Protocols
Laboratory specimen collection and testing procedures, laboratory safety information, and guidance for shipping specimens/isolates for further testing; includes information on the Laboratory Response Network, an integrated national and international network of laboratories that are fully equipped to respond quickly to acts of chemical or biological terrorism, emerging infectious diseases, and other public health threats and emergencies.

eMedicine

Emergency Medicine: Chemical and Biological Warfare Agents and Topics
An extensive list of chemical and biological warfare agents and related information from the world's largest medical textbooks.

Food and Drug Administration (FDA), Center for Drug Evaluation and Research

Drug Preparedness and Response to Chemical Emergencies
To help prepare the United States for possible terrorism attacks, the FDA is working with other federal agencies to make sure adequate supplies of medicine and vaccines are available to the American public. This Web site provides links to current information on antidotes for chemical poisoning.

National Institute for Occupational Safety and Health (NIOSH)

Chemical Agents: Emergency Response Cards

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Your feedback is welcome. E-mail comments to: disastercd@ama-assn.org.

Reporting Safety and Security Concerns

Federal, state, and local officials are responsible for working together to develop community and hospital response plans for the management of chemical emergencies. A coordinated communication network is critical for transmitting reliable information from the incident scene to treatment facilities. Clinicians should be aware of such plans and knowledgeable of whom to contact for situations involving:

- any accident involving a hazardous material spill or chemical release of a potentially noxious chemical agent;
- lost or stolen chemical supplies; or
- any threat, theft, smuggling, vandalism, or terrorist activity involving a chemical facility or transport vehicle.

Any suspicious or confirmed disaster situation should be reported immediately to the local 9-1-1 emergency response number. If you believe that someone has been exposed deliberately to a biological, chemical, or radioactive agent, or if you believe an intentional terrorist threat will occur or is occurring, please contact your local health department, your local police or other law enforcement agency, and the **Centers for Disease Control and Prevention (770-488-7100)**. Any incident related to terrorism or possible terrorist activity also requires telephonic notification to the **National Response Center at 800-424-8802**. This includes bombings, bomb threats, suspicious letters or packages, and incidents related to the intentional release of chemical, radiological, and biological agents.

National Contacts

American Association of Poison Control Centers (AAPCC)
Poisoning Emergency Hotline: 800-222-1222

Centers for Disease Control and Prevention (CDC)
Emergency 24-hour Response Hotline: 770-488-7100

Clinician email: coca@cdc.gov
Clinician information line: 877-554-4625

Public email: cdcresponse@ashastd.org
Public information line: 888-246-2675

What to do in an Emergency
Key contact information from CDC's Emergency Preparedness and Response Web site

Laboratory Testing, Shipping, and Reporting Information and Protocols

Chemical Transportation Emergency Center (CHEMTREC)
24-hour Emergency Response Hotline: 800-424-9300

National Response Center
24-hour Emergency Hotline: 800-424-8802

Regional Contacts

State Contacts

Local Contacts

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Additional Resources

Personal and Family Protection from Chemical Disasters

American Academy of Pediatrics (AAP)

Children, Terrorism & Disasters

Seeks to ensure: (1) that pediatricians and other pediatric providers have the information they need about terrorism and disasters as fast as it becomes available; (2) that children's needs are considered in all terrorism and disaster planning and response efforts; and (3) functioning linkages with all national, state and local governmental and private entities working on issues concerning terrorism and disasters.

American Red Cross

Chemical Emergencies

General information for individuals and families to prepare for and respond to chemical emergencies

Centers for Disease Control and Prevention (CDC)

Chemical Agents: Facts About Sheltering in Place

How to find temporary shelter in an emergency

Chemical Agents: Facts About Evacuation

Knowing when and how to evacuate an area in an emergency

Chemical Agents: Facts About Personal Cleaning and Disposal of Contaminated Clothing

What to do if you come in physical contact with dangerous chemicals

Chemical Emergencies

Entry portal to comprehensive CDC Web site containing resources for the public and emergency responders to help them prepare for and cope with a chemical emergency

Department of Homeland Security (DHS)

Be Informed: Chemical Threats

Quick reference guide for personal and family protection from potentially hazardous chemicals

Federal Emergency Management Agency (FEMA)

Hazardous Materials

Fact sheets and background information on chemical substances used in industry, agriculture, medicine, research, and consumer goods, which are most often released as a result of transportation accidents or because of chemical accidents in industrial plants.

National Disaster Education Coalition

Chemical Emergencies at Home

Various chemicals used in industry, agriculture, medicine, research, and consumer goods pose a public and environmental health threat if released or misused. These substances are most often released as a result of transportation accidents or because of chemical accidents in manufacturing plants.

Hazardous Materials Incidents
Information on preparing for and responding to hazardous material incidents, ranging from a chemical spill on a highway to the contamination of groundwater by pesticides and other chemicals.

Virginia Department of Emergency Management

Terrorism Information: Chemical Agents
Comprehensive public information, in question-and-answer format, on dangerous chemical agents and planning for emergency situations

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Management of Exposed Victims

Agency for Toxic Substances and Disease Registry (ATSDR)

Managing Hazardous Material Incidents

A 3-volume series (with a video) comprised of recommendations for on-scene (prehospital) and hospital medical management of patients exposed during a hazardous materials incident.

- Volume I – *Emergency Medical Services: A Planning Guide for the Management of Contaminated Patients* (provides guidance to first responders in planning for incidents that involve hazardous materials)
- Volume II – *Hospital Emergency Departments: A Planning Guide for the Management of Contaminated Patients* (assists hospital emergency department personnel in planning for incidents involving hazardous materials)
- Volume III – *Medical Management Guidelines for Acute Chemical Exposures* (guidance for health care professionals who treat persons exposed to hazardous materials)
- Video – *Community Challenge: Hazardous Materials Response and the Emergency Medical System* (training video for Volumes I and II)

Medical Management Guidelines for Unidentified Chemicals

Management of patients exposed to an unidentified hazardous material

Public Health Statements

Summaries providing information in question-and-answer format to address the most frequently asked questions about exposure to hazardous substances found around hazardous waste sites and the effects of exposure on human health.

ToxFAQs™

Fact sheets with easy to understand answers to the most frequently asked questions (FAQs) about exposure to various hazardous substances and the effects of exposure on human health.

Toxicological Profiles on Various Hazardous Chemicals

American Academy of Pediatrics (AAP)

Chemical-Biological Terrorism and Its Impact on Children; A Subject Review

Reviews key aspects of chemical and biological agents, the consequences of their use, the potential impact of a terrorist attack on children, and issues to consider in disaster planning and management for pediatric patients

American Hospital Association (AHA)

Chemical and Bioterrorism Preparedness Checklist

Checklist for hospitals to help them describe and assess their present state of preparedness for chemical and biological incidents.

American Medical Association (AMA)

Diagnosis and Management of Foodborne Illnesses: A Primer for Physicians and Other Health Care Professionals

Created though a partnership of the AMA and the American Nurses Association-American Nurses Foundation in conjunction with the CDC's Food Safety Office, the Food and Drug Administration's Center for Food Safety and Applied Nutrition, and the U.S. Department of Agriculture's Food Safety and Inspection Service, this educational guide assists health care professionals to detect foodborne illness — including the deliberate contamination of food.

Centers for Disease Control and Prevention (CDC)

In addition to the following resources, the CDC provides a free registry to provide clinicians with real-time information to help prepare for (and possibly respond to) terrorism and other emergency events. Participants receive regular e-mail updates on terrorism and other relevant emergency issues and training opportunities.

Chemical Agents – Listed by Chemical

Chemical Agents – Listed by Disease Syndrome/Category

Chemical Emergencies

Entry portal to comprehensive CDC Web site containing resources for the public and emergency responders to help them prepare for and cope with a chemical emergency

Emergency Room Procedures in Chemical Hazard Emergencies: A Job Aid

Preparations, victim arrival, initial treatment, identification of chemical agents, and protocols.

Health Advisory Alert Network

A nationwide, integrated information and communications system serving as a platform for distribution of health alerts and national disease surveillance information, as well as for dissemination of prevention guidelines and distance learning opportunities to support CDC initiatives to strengthen emergency preparedness at the local and state levels.

Laboratory Response Network (LRN)

An integrated network of state and local public health, federal, military, and international laboratories that can respond to both bioterrorism and chemical terrorism

Public Health Response to Biological and Chemical Terrorism: Interim Planning Guidance for State Public Health Officials

Developed to assist state public health officials determine their agency's roles in a biological or chemical terrorism event and to understand emergency response roles of local health departments, the emergency management system, and other entities.

Strategic National Stockpile

National program to ensure the availability and rapid deployment of life-saving pharmaceuticals, antidotes, other medical supplies, and equipment necessary to counter the effects of chemical agents, biological pathogens, and trauma. The CDC provides such supplies at 10 locations across the country. Called "push packs," they are filled with antibiotics, vaccines, antidotes, antitoxins, and other medical supplies that can be delivered anywhere in the United States within 12 hours in the event of an emergency.

Center for the Study of Bioterrorism, Saint Louis University School of Public Health

Chemical Terrorism

A compilation of clinical resources on various chemical weapons agents

Department of Transportation (DOT)

Emergency Response Guidebook

Developed jointly by the DOT, Transport Canada, and the Secretariat of Transport and Communications of Mexico for use by fire fighters, police, emergency services personnel, and other first responders in quickly identifying the specific or generic hazards of potentially dangerous materials involved in a transportation-related emergency and protecting themselves and the public during the initial response phase of the incident.

eMedicine

Warfare – Biological, Chemical, Radiological, Nuclear, and Explosive

An extensive list of online articles on the evaluation and treatment of victims exposed to various biological, chemical, explosive, incendiary, and radioactive agents, including personal protection measures

Environmental Protection Agency (EPA)

Chemical Emergency Preparedness and Prevention

Provides technical assistance to prevent and prepare for chemical emergencies, respond to environmental crises, inform the public about chemical hazards in their community, and share lessons learned about chemical accidents.

EPA Envirofacts Warehouse

Contains chemical data from several different program system databases and potentially hazardous agents.

Extremely Hazardous Substances (EHS): Chemical Profiles and Emergency First Aid Guides

Information about more than 300 EHS currently listed as part of Section 302 of the Emergency Planning and Community Right-to-Know Act. Each chemical profile includes physical/chemical properties, health hazards, fire and explosion hazards, reactivity data, precautions for safe handling and use, and protective equipment for emergency situations. The first aid guide provides signs and symptoms of poisoning and emergency treatment for first responders. The chemical profiles and first aid guides may be accessed from either the CAS number or alphabetical list of EHS.

Food and Drug Administration (FDA) Center for Drug Evaluation and Research

Drug Preparedness and Response to Chemical Emergencies

To help prepare the country for possible terrorism attacks, the FDA is working with other federal agencies to make sure adequate supplies of medicine and vaccines are available to the American public. This Web site provides links to current information on antidotes for chemical poisoning.

Mailman School of Public Health, Columbia University

National Center for Pediatric Preparedness Consensus Report

National consensus conference report and recommendations for ensuring the needs of children are met in planning and preparing for disasters and terrorist events

National Institute for Occupational Safety and Health (NIOSH)

Chemical Agents: Emergency Response Cards

Information for first responders includes agent-specific identification, medical symptoms, prevention, and personal protective equipment, fire fighting, sampling and analytical methods, decontamination, spillage disposal, packaging, and labeling information.

Guidance for Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks

Preventive measures that building owners and managers can take to protect building air environments from a terrorist release of contaminants.

NIOSH Approved Respirators

Information on testing and certifying self-contained breathing apparatus (SCBA) for use by emergency responders in chemical, biological, radiological, and nuclear (CBRN) environments

NIOSH Pocket Guide to Chemical Hazards

Source of general industrial hygiene information on several hundred chemicals/classes for workers, employers, and occupational health professionals.

National Library of Medicine (NLM)

Household Products Database: Health and Safety Information

This database links over 5,000 consumer brands to potential health effects and allows scientists and consumers to research products based on chemical ingredients. Information in the database derives from a variety of publicly available sources including brand-specific labels, Material Safety Data Sheets provided by manufacturers, and manufacturers' Web sites.

TOXLINE – Toxicology Information Online

TOXLINE records provide bibliographic information covering the biochemical, pharmacological, physiological, and toxicological effects of drugs and other chemicals.

U.S. Army

Center for Health Promotion and Preventive Medicine

Chemical Warfare Agents (CWA) and Associated Health Guidelines

Includes information and links to sites that provide information on basic chemical, physical, and toxicological properties of CWA. Information on health-related guidance and current environmental/policy issues is also available.

Detailed Chemical Fact Sheets
Technical fact sheets with physical properties, toxicity data, and emergency first aid information for various chemical hazards

General Chemical Fact Sheets
Brief, non-technical, facts sheets with general information on various chemical hazards

Medical Research Institute of Chemical Defense (USAMRICD)

Field Management of Chemical Casualties Handbook
Provides military and civilian emergency response personnel with a concise reference source for the medical management of chemical casualties in a field environment. In addition to providing information on the various chemical agents and their emergency treatment, it also covers the set up of a medical decontamination line and detection/decontamination equipment and supplies used by the military for field medical decontamination.

Medical Management of Chemical Casualties Handbook
Provides medical personnel with a concise yet detailed reference source for the medical management of chemical casualties, including history, triage, diagnosis, and treatment.

Other Army Field Manuals and Handbooks

Health Service Support in a Nuclear, Biological and Chemical Environment (FM 4-02.7)
Field manual providing tactics, techniques, and procedures for health service support personnel operating in a hazardous nuclear, radiological biological, and chemical environment.

NATO Handbook on the Medical Aspects of NBC Defensive Operations Part III – Chemical
Guide for medical officers on the medical aspects of nuclear, biological and chemical (NBC) operations. The handbook is in three parts, Part I-Nuclear, Part II-Biological, and Part III-Chemical. There is some necessary overlap and several aspects are common to all three, for example: combined injuries; the effect of radiation on the response to infection and on the healing of thermal and chemical burns; psychological factors and morale; public health aspects; and medical care in a mass casualty situation.

The Medical NBC Battlebook (Army Tech Guide 244)
Addresses operational health concerns related to NBC threats, protective clothing and measures, and management of NBC casualties

Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries
(FM 8-285)
Serves as a guide and a reference for trained members of the Armed Forces Medical Services and other medically qualified personnel on the recognition and treatment of chemical agent casualties and conventional military chemical injuries. Additionally, it provides information on first aid (self-aid, buddy aid, and combat lifesaver aid) for these casualties.

U.S. Soldier and Biological Chemical Command, Edgewood Chemical Biological Center

Guidelines for Mass Casualty Decontamination During a Terrorist Chemical Agent Incident

Guidelines for Mass Fatality Management During Terrorist Incidents Involving Chemical Agents

Guidelines for Responding to a Chemical Weapons Incident

World Health Organization (WHO)

Public Health Response to Biological and Chemical Weapons

Guidance report provides analyses of the health aspects of the possible hostile use of biological or chemical agents. It describes how biological and chemical agents may endanger public health; provides the standard principles of risk management to prepare for the deliberate release of biological or chemical agents; and presents national and international laws, including their potential role in mobilizing international assistance and available sources of such assistance.

World Medical Leaders

Chemical Terrorism Resources

World Medical Leaders was founded to create a physicians-only Internet site where doctors from around the world could learn from and interact with a distinguished medical faculty. The Web site provides practicing physicians with original, CME-certified lectures and up-to-date resources on chemical terrorism and other topics.

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Your feedback is welcome. E-mail comments to: disastercd@ama-assn.org.

Suggested Reading List

American Medical Association (AMA). *JAMA* Terrorism Preparedness Collection
On-line collection of articles from the *Journal of the American Medical Association* dealing with biological and chemical agents and terrorism.

Army Medical Research Institute of Chemical Defense (USAMRICD)
Medical Management of Chemical Casualties Handbook (July 2000)
Provides medical personnel with a concise yet detailed reference source for the medical management of chemical casualties, including history, triage, diagnosis, and treatment.

Committee on Environmental Health and Committee on Infectious Diseases, American Academy of Pediatrics (AAP). Chemical-biological terrorism and its impact on children: a subject review. *Pediatrics*. 2000;105:662-670.
Reviews key aspects of chemical and biological agents, the consequences of their use, the potential impact of a terrorist attack on children, and issues to consider in disaster planning and management for pediatric patients

American College of Emergency Physicians (ACEP), U.S. Department of Health and Human Services Office of Emergency Preparedness. *Developing Objectives, Content, and Competencies for the Training of Emergency Medical Technicians, Emergency Physicians, and Emergency Nurses to Care for Casualties Resulting from Nuclear, Biological, or Chemical (NBC) Incidents*. Dallas, Texas: American College of Emergency Physicians;2001.

Centers for Disease Control and Prevention (CDC).
Biological and Chemical Terrorism: Strategic Plan for Preparedness and Response: Recommendations of the CDC Strategic Planning Workgroup
MMWR. 2000;49(RR-4): 1-14

Recognition of Illness Associated with Exposure to Chemical Agents
MMWR. 2003; 52:938-940.
Summarizes the epidemiologic clues and clinical signs or patterns of illness that might suggest covert release of a chemical agent

Committee on R&D Needs for Improving Civilian Medical Response to Chemical and Biological Terrorism, institute of Medicine. Chemical and Biological Terrorism: Research and Development to Improve Civilian Medical Response. Washington, DC; National Academy Press; 1999.

Kales SN, Christiani DC. Current concepts: acute chemical emergencies. *N Engl J Med.* 2004;350:800-808.
Reviews health effects most commonly associated with the short-term release of industrial and environmental chemicals and the use of chemical weapons; also emphasizes the recognition of four clinical syndromes, or “toxidromes,” that are applicable to most scenarios of accidental release of chemicals and deliberate release as in acts of chemical terrorism.

Office of the U.S. Army Surgeon General. Textbook of Military Medicine: Medical Aspects of Chemical and Biological Warfare

A comprehensive reference on the history, development, use, and medical management of chemical and biological warfare agents.

World Health Organization (WHO). Public Health Response to Biological and Chemical Weapons. Geneva: WHO; 2004.

Guidance report provides analyses of the health aspects of the possible hostile use of biological or chemical agents. It describes how biological and chemical agents may endanger public health; provides the standard principles of risk management to prepare for the deliberate release of biological or chemical agents; and presents national and international laws, including their potential role in mobilizing international assistance and available sources of such assistance.

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